

Ocean stored significant warming over last 16 years

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The upper layer of the world's ocean has warmed steadily since 1993, indicating a strong climate change signal, according to a new study. The energy stored is enough to continuously power nearly 500, 100-watt light bulbs per person worldwide.

“We are seeing the global ocean store more heat than it gives off,” said John Lyman, an oceanographer at [NOAA's](#) Joint Institute for Marine and Atmospheric Research, who led an international team of scientists that analyzed nine different estimates of heat content in the upper ocean from 1993 to 2008.

The team combined the estimates to assess the size and certainty of growing heat storage in the ocean. Their findings will be published in the May 20 edition of the journal *Nature*. The scientists are from NOAA, NASA, the Met Office Hadley Centre, the University of Hamburg and the Meteorological Research Institute in Japan.

Josh Willis, an oceanographer at the NASA Jet Propulsion Laboratory and one of the scientists who contributed to the study said: “The ocean is the biggest reservoir for heat in the climate system, so as the planet warms, we’re finding that 80 to 90 percent of the increased heat ends up in the ocean.”

A warming ocean is a direct cause of global sea level rise, since seawater expands and takes up more space as it heats up, accounting for about one-third to one-half of global sea level rise.

Combining multiple estimates of heat in the upper ocean — from the surface to about 2,000 feet down — the team found a strong multi-year warming trend throughout the world's ocean. According to measurements by an array of autonomous free-floating ocean floats called Argo as well as by earlier devices called expendable bathythermographs or XBTs that were dropped from ships to obtain temperature data, ocean heat content has increased over the last 16 years. The team notes that there are still some uncertainties and some biases.

Gregory Johnson, an oceanographer with NOAA's Pacific Marine Environmental Laboratory said: “The XBT data give us vital information about past changes in the ocean, but they are not as accurate as the more recent Argo data. However, our analysis of the data gives us confidence that on average, the ocean has warmed over the past decade and a half, signaling a climate imbalance.”

Data from the array of Argo floats — deployed by NOAA and other U.S. and international partners — greatly reduce the uncertainties in estimates of ocean heat content over the past several years, the team said. There are now more than 3,200 Argo floats distributed throughout the world's ocean sending back information via satellite on temperature, salinity, currents and other ocean properties.

Notes to editors

- Robust Warming of the Global Upper Ocean by John M. Lyman, Simon A. Good, Viktor V. Gouretski, Masayoshi Ishii, Gregory C. Johnson, Matthew D. Palmer, Doug M. Smith, and Josh K. Willis is published in *Nature* on 20 May 2010.
- The Met Office Hadley Centre worked with the Joint Institute for Marine and Atmospheric Research at the University of Hawaii, NOAA/Pacific Marine Environmental Laboratory, the University of Hamburg, Climate Meteorological Research Institute, Japan and NASA Jet Propulsion Laboratory.
- The Met Office Hadley Centre advises the UK government on climate change research. Its work is, in part, jointly funded by Defra (Department for Environment, Food and Rural Affairs) and DECC (Department for Energy and Climate Change).

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